

Davis Bridge

Spanning the Upper Iowa River on County Road 16

Lime Springs vicinity

Howard County

Iowa

HAER No. IA-35

HAER
IOWA,
45-LISRV
1-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
Rocky Mountain Regional Office
National Park Service
U.S. Department of the Interior
P.O. Box 25287
Denver, Colorado 80225

HISTORIC AMERICAN ENGINEERING RECORD

HAER
IOWA,
45-LISP.
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Davis Bridge

HAER No. IA-35

Location: Spanning the Upper Iowa River on Howard County Road 16, Section 20, Township 100 North, Range 12 West; Forest City Township; 1.5 miles northwest of Lime Springs, Howard County, Iowa

UTM: 15.556840.4812670

Quad: Lime Springs, Iowa (7-1/2 Minute Series, 1981)

Date of Construction: 1879

Designer: Wrought Iron Bridge Company, Canton, Ohio

Builder: Wrought Iron Bridge Company, Canton, Ohio

Fabricator: Wrought Iron Bridge Company, Canton, Ohio

Present Owner: Howard County, Iowa

Present Use: Roadway bridge (presently closed to traffic and scheduled for replacement in 1992)

Significance: Built in 1879, the Davis Bridge was one of a handful of iron spans erected in Howard County following the failure of several early timber structures. It was fabricated and built by the Wrought Iron Bridge Company, perhaps the most prolific 19th century iron bridge fabricator in the country. The wrought iron composition and bowstring configuration of the Davis Bridge clearly place it in the milieu of 1870's bridge construction. But its pinned connections and boxed-channel arches are features more commonly associated with later truss technology. The Davis Bridge is thus distinguished as a transition between two mainstay 19th century wagon bridge types: the bolted bowstring arch-truss and the pinned Pratt truss. The oldest wagon bridge remaining in Howard County and one of the oldest in Iowa, the Davis Bridge is both historically and technologically significant to the development of bridge building in Iowa.

Report Assembled by: Ron D. Ashback-Sladek and Clayton B. Fraser
Fraserdesign
Loveland, Colorado

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This Historic American Engineering Record [HAER] documentation for the Davis Bridge was conducted by Fraserdesign of Loveland, Colorado, under contract with Van Winkle-Jacob Engineering, Inc., of Iowa City, Iowa. The Howard County Engineer has proposed replacing the structure in 1992, and this recordation is intended to mitigate in part the impact on the bridge by this action. Field recording and research for the Davis Bridge were undertaken in August 1991; this report was completed in December 1991. Research for the project has involved three archival sources: the Howard County Auditor's Office and the Howard County Engineers' Office at the Howard County Courthouse and the Howard County Public Library, all three located in Cresco, Iowa.

The first settlers arrived in northeastern Iowa in the early 1850s. Originally part of Chickasaw County, Howard County was established in 1855, when in response to citizens' petitions the Chickasaw County Court ordered an election for a new county government. Forest City Township, in the northeastern quadrant of the newly formed county, was officially organized a year later. The township's growing community established two small towns - Foreston (now Forest City) and Lime Springs - along the Upper Iowa River. Lime Springs was settled in 1854 and platted by 1857. In 1859 a water-powered mill was constructed here beside the river. The mill soon became the center of agricultural activity in the township, as area grain farmers hauled their harvests to Lime Springs to be ground into flour.¹

Although the Civil War slowed immigration into Howard County, the war's end brought renewed settlement. In the mid-1860s the Milwaukee and St. Paul Railroad built a line through the region, locating a depot less than a mile south of Lime Springs. The town of Lime Springs Station grew quickly around the new depot, incorporating by 1868. Bypassed by the railroad, the original town of Lime Springs was virtually abandoned within a few years, as residents rebuilt in Lime Springs Station. Eventually, the new settlement became known as Lime Springs; the original town has since been called "Old Lime Springs". The town of Chester, three-and-one-half miles northwest of Lime Springs Station, was also relocated to the railroad depot built nearby.²

These emerging settlements tended to concentrate along the rivers, the largest in Howard County being the Upper Iowa River. Entering the county from the northwest, the Upper Iowa meanders across to the northeast, from where it makes its way to the Mississippi River. Other significant streams in the county include the Big Wapsipinicon, Little Wapsipinicon, Turkey River and Crane Creek. Additionally, the county is crisscrossed by a myriad of creeks, streams, runs, gullies, ravines and washes. Although numerous, these

watercourses were not particularly wide or deep, nor did they present any great technological difficulties in bridging. Nevertheless, they did impede travel over the region's developing system of wagon roads. Bridged crossings would be required for settlement to continue and commerce to increase.

Responsibility for organized road and bridge building fell to the county government. The typical method of communication between citizens and elected officials was through road and bridge petitions, which were used to request specific construction or improvements. Beginning in 1860, petitions were considered by the Howard County Board of Supervisors at its regularly scheduled meetings, held in the new county courthouse in Cresco after 1867.³ The supervisors responded to the deluge of urgent bridge petitions in the 1860s by authorizing many small-scale projects, but no long-span structures. The predictable result was a collection of short spans, with limited utility and questionable structural capacity. In February 1861 the Committee on Highways and Bridges complained to the board: "The bridges of the county to great an extent are unfinished upon important thoroughfares, large amounts have been expended and are entirely useless, for the want of a sufficient sum to complete said work." The committee recommended that the county begin appropriating funds to the townships for completion of bridges. The board adopted the plan, allowing the townships to contract directly for bridge construction and repair.⁴

In 1865-66 the county halted this method of appropriations and again dealt with bridge contractors itself. After reviewing petitions, the Committee on Highways and Bridges typically made its recommendations to the Board of Supervisors. Although many petitions were accepted, numerous others were rejected for various reasons, most commonly a lack of available funds. The committee responded to a June 1866 petition, for instance, by stating that its three members "with much reluctance have concluded that in view of the present financial condition of the county that it is not expedient to grant the prayer of said petitioners at present." That year the supervisors instituted bridge inspections to assert greater control over the quality of workmanship, determine appropriate locations for construction projects, and ensure that funds were spent efficiently.⁵

For a new county faced with a rapidly increasing number of rural roads and an acute shortage of funds, the construction of many small timber bridges was the most practical short-term solution. Though inexpensive to build, many of these wooden spans were structurally suspect, requiring almost continuous maintenance to prevent their collapse. From the beginning, the county found itself frequently rebuilding bridges that had fallen due to floods or structural failure. Because of recurrent damage to decks, the supervisors in 1867 began levying fines against anyone caught crossing a county bridge with a horse moving faster than a walk.⁶

In the late 1860s the county apparently began contracting for more substantial structures, as evidenced by the jump in construction funding for several new projects. In June 1867 the bridge committee recommended that \$1500 be appropriated for construction of a wagon bridge across the Turkey River at New Oregon. Several months later the

committee recommended that \$2000 be appropriated for a high-water bridge over the Upper Iowa River at Lime Springs.⁷ Prior appropriations had fallen well below a thousand dollars per bridge.⁸

During the early 1870s, the board of supervisors was faced with a rash of bridge failures, including the collapse of the wooden bridges at Lime Springs and New Oregon and the advanced deterioration of the Hewett and Vernon Springs bridges.⁹ These failures prompted the supervisors to turn to all-metal bridges as a better, more reliable technology. In what may be seen as a watershed in Howard County bridge-building, the supervisors began contracting for the more expensive iron bridges on a regular basis in 1875. The county eventually erected metal spans at the Foreston, New Oregon, Lime Springs, Crane Creek, Chester, Florenceville, Davis and Searles crossings by the turn of the century.¹⁰ Between 1875 and 1900, the county contracted for all-metal bridges with the Wrought Iron Bridge Company (Canton OH), the Canton Bridge Company (Canton OH), the Penn Bridge Works (New Brighton PA), the Columbia Bridge Company (Dayton OH), the Chicago Bridge Company (Chicago IL) and local contractors D.H. Young of Manchester and J.G. Ratcliffe of Waukon.¹¹ Stone abutments and approaches were commonly built by local masons. By the end of the century, Howard County had followed the national trend in its transition from iron to steel superstructures.¹²

Among the bridge builders involved in Howard County in the 19th century, the Wrought Iron Bridge Company was perhaps the most active. The firm appears to have received its first contract from the county in 1878, when it was paid \$2600 for construction of a replacement bridge at Lime Springs. WIBCo went on to build three other bridges over the next five years: the Davis Bridge (1879), the Chester Bridge (1882) and the Searles Bridge (1884), all over the Upper Iowa River.¹³ As Howard County and hundreds of other Midwestern counties contracted with the Ohio-based bridge company in the 1870s, WIBCo quickly became one of the largest bridge fabricators in America. Its president, David Hammond, distinguished himself as one of the country's most prolific bridge innovators.

Born on September 12, 1830, in Plain Township, Ohio, David A. Hammond moved to Canton, Ohio, at the age of eighteen. There he served as an apprentice carpenter to William Prince, a locally prominent builder. By 1860 Hammond had formed his own construction company and was building, among other things, small-scale timber roadway bridges. With John Laird, owner of a local foundry, and Washington Reeves, a local metalworker, he developed a combination bridge in which he substituted iron for wood on some of the tension members and connection details. Hammond patented this design, the first in what would be a long series of bridge patents issued to him. In 1862 Hammond and Reeves built their first all-iron bridge over the Middle Branch of Nimishillen Creek in Canton, Ohio.¹⁴

The two men formed a partnership in 1864 to engage in bridge work and general contracting. That year they jointly patented their first bowstring arch-truss design and built a small fabricating plant on the Fort Wayne Railroad near the West Branch of Nimishillen Creek. Not satisfied with the small-scale construction undertaken by his partnership with Reeves, Hammond formed the Wrought Iron Bridge Company in 1865. In 1870, after years of operating at the same facility, Hammond and Reeves dissolved their partnership. Hammond continued to expand his bridge fabrication enterprise, eventually incorporating in 1871.¹⁵

The company immediately built a new fabricating plant in Canton, greatly increasing its production capacity. WIBCo's success throughout the 1870s was phenomenal. In 1871 the firm sold 100 bridges worth \$200,000. The following year sales had doubled to \$400,000, and by 1873 production had increased to a half million dollars.¹⁶ By August 1877 the Wrought Iron Bridge Company employed three hundred men, working around the clock to produce the 12,000 feet of iron bridges then under contract.¹⁷ WIBCo marketed its bridges across the country through the traditional means of solicitation and advertising. The company opened branch offices in several midwestern states from which it fielded general agents. Essentially traveling salesmen, these agents visited with city and county officials in their territories, explaining the company's bridge designs and presenting proposals for competitive bid lettings. The firm also advertised in national and regional trade periodicals and circulated illustrated pamphlets that showed examples of its work.

In 1874 Wrought Iron printed a "Book of Designs," which served both as an advertisement for the company and as a pattern book of standardized bridge designs that the firm manufactured. As indicated by the "Book of Designs," the primary structural type marketed by the company in the 1870s was the bowstring arch-truss comprised of wrought- and cast-iron components. The bowstring was the most commonly erected all-metal bridge of the 1870s, due in large part to WIBCo and its main competitor, the King Iron Bridge and Manufacturing Company of Cleveland, Ohio. The first and second largest bridge manufacturers in the country during the decade, both companies fabricated standardized versions of their own patented bowstring designs. By altering the configuration of the arches and suspenders on its bridges, WIBCo was able to produce a series of bowstrings covering a range of span lengths from 50 to 350 feet.

The counties and municipalities of Iowa were among the best customers of the Wrought Iron Bridge Company. The period of extensive rural road and bridge construction in the state during the 1870s coincided with WIBCo's ascendance in the industry, combining to create a booming market for the bridge company's regional sales representatives. Construction of the Davis Bridge in Howard County was just one of many projects with which the company was involved during the late 1870s in Iowa.

One of the spans erected by the Wrought Iron Bridge Company for Howard County in the late 1870s was a bowstring arch-truss on County Road 16 in Forest City Township. County Road 16, which runs northwesterly from old Lime Springs to Chester, had been established in August 1856 in response to a petition submitted by local resident A.D.C. Knowlton.¹⁸ The road crossed the Upper Iowa River a mile-and-a-half northwest of the new town of Lime Springs. An important crossing in the township, the first bridge at this location had been built by the early 1860s. The Hewett Bridge, so named after the adjacent landowner, was most likely a short-span timber structure, subject to frequent repair to the deck and substructure to keep it serviceable. This bridge first appears in the county supervisors' records in 1863, when \$50 were appropriated to officials of Forest City Township for repairs. In 1865 the county supervisors ordered the bridge re-planked "...as soon as possible as said bridge is in a very bad condition."¹⁹

After the collapse of the structure at Lime Springs in 1870, the county supervisors feared that other bridges over the Upper Iowa and Turkey rivers were "in dangerous condition and likely to fall." The Hewett Bridge was by then in need of repairs again, and the supervisors appropriated \$700 for its reconstruction, using timber salvaged from the fallen Lime Springs Bridge.²⁰ By 1879 the Hewett farm had been acquired by D.D. Davis, and the bridge once again needed extensive repairs. This time, instead of reconstructing the timber structure, the county opted to build an iron span supported by massive stone abutments and piers. In June the supervisors appropriated \$1500 for construction of the abutments, to be built, presumably, by local stonemasons. The supervisors then contracted with the Wrought Iron Bridge Company to fabricate and erect a 120-foot bowstring arch-truss for the crossing. By October the new bridge and its approaches were completed.²¹ Following its construction, the few records of the bridge, known by then as the Davis Bridge, are limited to adjustment and painting in the 1880s and a partial reconstruction of the west approach in 1898.²²

With a 120-foot span length and a 15-foot roadway width, the Davis Bridge displays relatively modest dimensions. The superstructure consists of a single bowstring through arch-truss, the webs of which are subdivided into ten panels. The span is configured like all of WIBCo's bowstrings, with the arches and verticals acting in compression and the lower chords and diagonals acting in tension. The arches are comprised of rolled, wrought iron channels, covered with a continuous iron plate on top and joined back-to-back by batten plates beneath. The verticals consist of four angles, machine-riveted with double lacing. The diagonals are round eyerods with unslotted turnbuckles. The bottom chords are made up of two rectangular bars that extended continuously through the panel points. These chords are spliced at mid-panel using pins inserted through forged eyes in the bars. The struts that form the upper lateral bracing consist of four angles with lacing, braced diagonally by looped eyerods. The bridge is supported on all corners by cast-iron bearing shoes that rest on the stone substructure. The floor beams are I beams, U-bolted to the lower chords; the deck and stringers - replaced several times over the bridge's life - are wood.

The arches of the Davis Bridge differ from earlier bowstrings fabricated by WIBCo in that they used a boxed-channel configuration instead of the company's patented tubular shape. This wider profile allowed the use of full-width verticals that were pin-connected to the arches. WIBCo's standard tubular arches of the mid-1870s, by comparison, necessitated the use of tapered verticals that bolted to the arches using cast iron skew-backs. In these details, the Davis Bridge more closely resembles a pin-connected Pratt truss than a bowstring arch. This distinction is an important one, for the Davis Bridge was fabricated at a time in which the bowstring was being superseded across the country by the Pratt truss as a mainstay wagon bridge type. Designed as a hybrid between arch and truss, the Davis Bridge was one of the last bowstrings erected in Howard County.

It was appropriate that such a transitional bridge be built by the Wrought Iron Bridge Company. At the forefront of bowstring innovation in the 1870s, WIBCo was also at the forefront in the shift toward other structural configurations a decade later. David Hammond foresaw the decline of the bowstring arch-truss as a highway bridge type in the mid-1870s, as evidenced by his patent activity of the time. In an 1874 patent, he offered a single-intersection truss design as an alternative to the arch, stating: "The straight truss is simplified and made available for short spans in place of the arch, to which it is preferred for appearance, and also for the protection which the truss affords at the sides." Hammond's last patent for a bridge type, granted in 1876, was for a double-intersection through truss.²³

Another indication of Hammond's change of design appears in WIBCo's advertising. Of the fourteen standard bridge configurations presented in the company's 1874 "Book of Designs," half were bowstring variations. The illustration of a bowstring on the cover and the prominent placement of bowstrings first among the suggested designs indicates the intensity with which the company promoted this bridge type. A similar illustrated pamphlet issued by the company in 1885, however, contained no bowstrings at all among the standardized designs. Wrought Iron had by then dropped what had once been its mainstay bridge completely from its inventory. As this company and others discontinued the bowstring in its bid offerings, clients were guided toward alternative truss types.

The Davis Bridge is technologically significant for its representation of the transition from the bowstring arch-truss, with its bolted connections and tubular arches, to the pin-connected Pratt truss, which ultimately replaced the bowstring. Fabricated at a time in which the arch was being succeeded by the truss for general roadway usage, the bridge displays structural features of both technologies. As such, it exemplifies this watershed shift in bridge design. The Davis Bridge is the only example in Iowa and one of the few examples in the country of WIBCo's formative efforts to span the gap between arch and truss. It is also noteworthy as a well-preserved example of county bridge construction. Howard County's bridge building efforts during the 1870s typified a prevailing trend in the Midwest, in which the early timber structures, built during the region's initial settlement, were replaced by more substantial iron spans.

Finally, the Davis Bridge is significant simply for its existence. Although a great number of bowstrings were erected by Wrought Iron and other bridge fabricators in the 1860s and 1870s, few remain today. Iowa, once one of the WIBCo's largest customers, is typical of the national attrition. Of the thousands of bowstrings that once stood in the state, fewer than twenty now remain. The Davis Bridge is the only bowstring still standing in Howard County. It remains in an essentially rural setting on a farm-to-market road. Unable to function under current loading standards, however, the Davis Bridge has been closed and is scheduled to be replaced.

Endnotes

¹W. E. Alexander, *History of Chickasaw and Howard Counties, Iowa* (Decorah IA: Western Publishing Company, 1883), pages 444-450; "The Old Mill at Lime Springs," *Lime Springs (Iowa) Herald*, 9 June 1966, page 2; "Towns in County Proud of Histories," *The (Cresco Iowa) Times-Plain Dealer*, 15 June 1966, Section M, page 6; "County Formed in 1855," *The Times-Plain Dealer*, 15 June 1966, Section G, page 6; A.T. Andreas, *Illustrated Historical Atlas of the State of Iowa* (Chicago: Andreas Atlas Company, 1875), pages 50, 464.

²*Ibid.*, page 464.

³*Ibid.*

⁴Howard County Board of Supervisors, Record A, page 10 (27 February 1861); pages 84-85 (3 June 1862); page 122 (3 June 1863); pages 242-243 (5 June 1865); located at Howard County Courthouse, Cresco, Iowa.

⁵Howard County Board of Supervisors, Record A, pages 279-280 (16 October 1865); page 332 (8 June 1866); pages 342-343 (22 June 1866).

⁶Howard County Board of Supervisors, Record A, page 450 (14 November 1867).

⁷Both the New Oregon and Lime Springs bridges were replacement structures. In June 1866 County Supervisor Stephen Cadford reported to the board on the condition of the previous structure at Lime Springs: "I found on examination that there was [sic] two abutments and one pier built. One stone abutment built previous to the appropriation made at our last October session. One log crib filled with stone contracted and

built for one hundred seventy five dollars. And one log crib pier filled with stone contracted and built for two hundred dollars. The township trustees informed me said work was done according to previous contract made between them and the builders, but not in my opinion as sufficiently substantial as the nature of circumstances required, nor in a good workmanlike manner, not doubting but said trustees acted in good faith and to the best of their ability." Howard County Board of Supervisors, Record A, page 332 (27 February 1866).

⁸Howard County Board of Supervisors, Record A, pages 242-243 (5 June 1865); page 290 (28 November 1865); page 295 (1 January 1866); page 342 (22 June 1866); page 427 (7 June 1867); pages 435-436 (2 September 1867); pages 454-455 (7 January 1868); page 492 (3 June 1868).

⁹Howard County Board of Supervisors, Record B, page 102 (1 January 1872); page 190 (25-26 November 1873); page 191 (3 December 1873). Of these failures, the Lime Springs Bridge collapse ultimately proved the most costly, because it resulted in the death of one person. When the bridge was completed in 1868, the Committee on Highways and Bridges reported that the structure had not been built in accordance with the contract and would not be accepted. The contractors, Owen and Stephens, were paid anyway, but the county requested legal advice to determine whether use of the bridge constituted acceptance of the questionable construction. Two years later, in July 1870, the bridge collapsed, killing H. Kilber, who was crossing it at the time. Kilber's heirs sued the county and accepted a settlement of \$1250 three years later. Howard County then sued Owen and Stephens in an effort to recoup this loss.

¹⁰Howard County Board of Supervisors, Record B: page 299 (19 October 1875), page 313 (3 April 1876), page 373 (30 June 1877), page 385 (19 October 1877), Foreston Bridge; page 314 (7 April 1876), page 319 (19 April 1876), New Oregon Bridge; page 437 (14 October 1878), Lime Springs Bridge; page 541 (9 September 1880), Crane Creek Bridge; page 574 (8 April 1881), page 610 (2 January 1882), Chester Bridge; page 610 (2 January 1882), reference to adjustment of iron bridges at New Oregon, Florenceville, Foreston, Lime Springs and Davis. Record C: page 69 (8 January 1884), page 99 (4 September 1884), Searles Bridge. This pattern continued through the early 1900s.

¹¹Howard County Bridge Record #1, Bridge 135, 1876, located at Howard County Courthouse, Cresco, Iowa. Howard County Supervisors Record B, page 290 (16 September 1875); page 299 (19 October 1875); page 313 (3 April 1876); page 314 (7 April 1876); page 319 (19 April 1876); page 373 (30 June 1877); page 385 (19 October 1877); page 437 (14 October 1878); page 488 (20 October 1879); page 509 (15 January 1879).

¹²Howard County Auditor's Office, Howard County Courthouse, bridge contracts between J.G. Ratcliffe, contractor, and Howard County for construction of steel bridges (25 October 1895, 1 November 1896); bridge contracts between D.H. Young, contractor, and Howard County (8 April 1897, 15 November 1898); bridge contracts between J.G.

Ratcliffe, contractor, and Howard County (2 January 1899, 26 June 1899, 17 April 1900, 8 June 1904). Howard County Board of Supervisors, Book E, page 39 (10 November 1903) and page 50 (13 January 1903).

¹³Howard County Board of Supervisors, Record B, page 437 (14 October 1878), page 488 (20 October 1879), page 610 (2 January 1882); Record C, page 99 (4 September 1884).

¹⁴"Bridge Building," *The American Pictorial Monthly*, Mid-Summer Edition 1902, page 25; "Third Street S. E. Bridge - 1883, Canton, Ohio," unpublished report, Ohio State Historical Society, pages 4-5.

¹⁵*Book of Designs of Wrought Iron Bridges Built by the Wrought Iron Bridge Company of Canton, Ohio* (Canton, Ohio: Hartzell & Saxton, 1874), page 2; William Henry Perrin, *History of Stark County, Ohio* (Chicago: Baskin & Batley, 1881), page 337.

¹⁶"Third Street S. E., Bridge - 1883, Canton, Ohio," page 14; Stark County (Ohio) Commissioners' Journal, Volume 5 (1864-1874).

¹⁷*Engineering News*, 25 August 1877.

¹⁸Howard County Road Record A, pages 12, 14, 18, 28; Howard County Road Calendar B, page 17, located at Howard County Courthouse, Cresco, Iowa.

¹⁹Howard County Board of Supervisors, Record A, page 122 (3 June 1863), pages 228-229 (6 January 1865), pages 279-280 (16 October 1865), page 332 (8 June 1866), page 379 (15 October 1866), page 450 (4 November 1867).

²⁰Howard County Board of Supervisors, Record B, page 20 (6 June 1870), page 36 (16 July 1870), page 47 (17 October 1870).

²¹Howard County Board of Supervisors, Record B, page 464 (7 April 1879), page 476 (12 June 1879), page 488 (20 October 1879).

²²Howard County Board of Supervisors, Record B, page 610 (2 January 1882); Record C, page 117 (15 June 1885).

²³Patent file 184,520; 21 November 1876.

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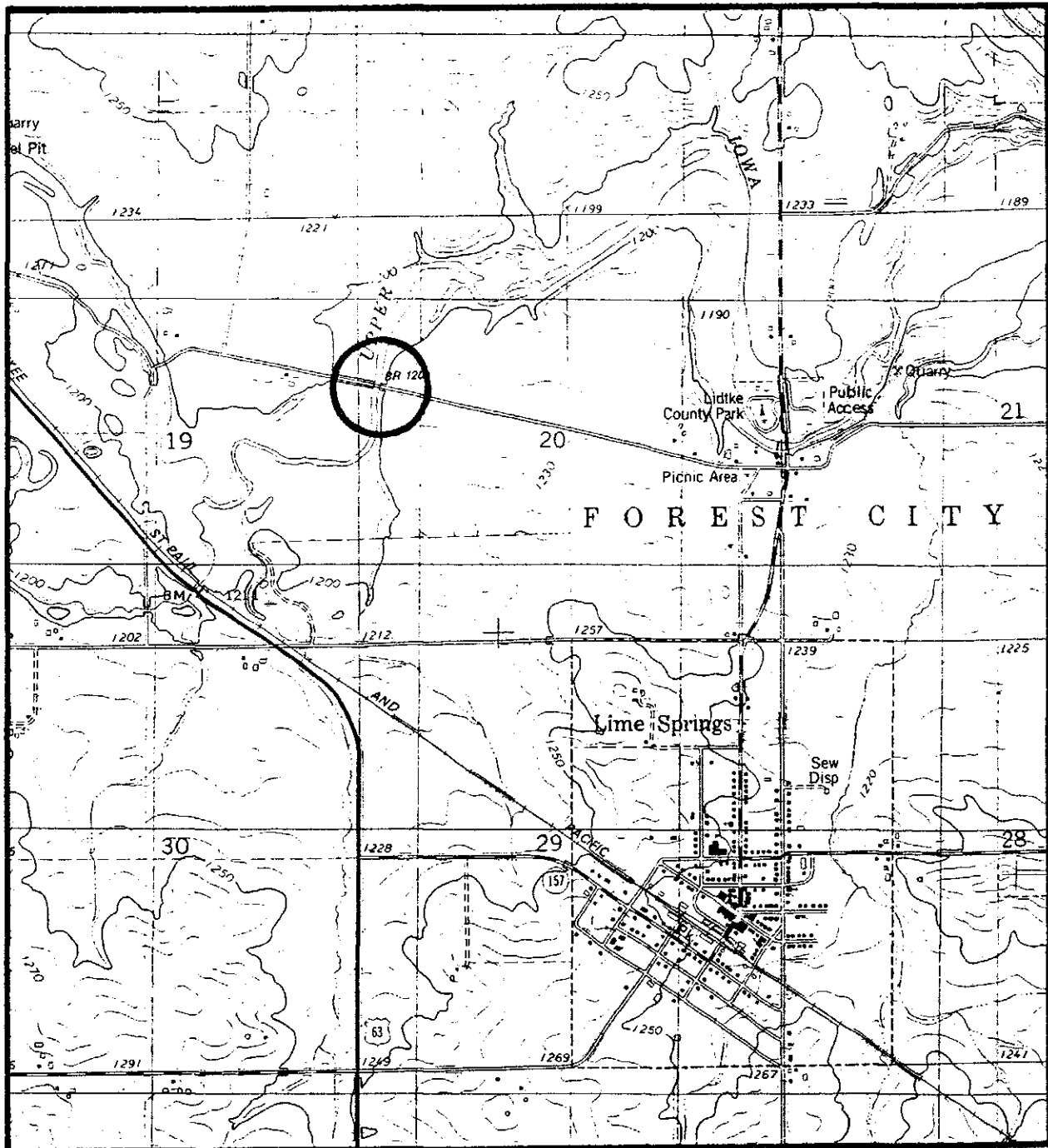
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Taken from USGS Lime City, Iowa, quadrangle map [7.5 minute series, 1981].